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Effects of mobile Internet use on college student pedestrian injury risk

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ABSTRACT

Background: College-age individuals have the highest incidence of pedestrian injuries of any age cohort. One factor that might contribute to elevated pedestrian injuries among this age group is injuries incurred while crossing streets distracted by mobile devices.
Objectives: Examine whether young adult pedestrian safety is compromised while crossing a virtual pedestrian street while distracted using the Internet on a mobile "smartphone."
Method: A within-subjects design was implemented with 92 young adults. Participants crossed a virtual pedestrian street 20 times, half the time while undistracted and half while completing an email-driven "scavenger hunt" to answer mundane questions using mobile Internet on their cell phones. Six measures of pedestrian behavior were assessed during crossings. Participants also reported typical patterns of street crossing and mobile Internet use.
Results: Participants reported using mobile Internet with great frequency in daily life, including while walking across streets. In the virtual street environment, pedestrian behavior was greatly altered and generally more risky when participants were distracted by Internet use. While distracted, participants waited longer to cross the street ($F = 42.37$), missed more safe opportunities to cross ($F = 42.63$), took longer to initiate crossing when a safe gap was available ($F = 53.03$), looked left and right less often ($F = 124.68$), spent more time looking away from the road ($F = 1959.78$), and were more likely to be hit or almost hit by an oncoming vehicle ($F = 29.54$; all $ps < 0.01$). Results were retained after controlling for randomized order; participant gender, age, and ethnicity; and both pedestrian habits and mobile Internet experience.
Conclusion: Pedestrian behavior was influenced, and generally considerably riskier, when participants were simultaneously using mobile Internet and crossing the street than when crossing the street with no distraction. This finding reinforces the need for increased awareness concerning the risks of distracted pedestrian behavior.

1. Introduction

In 2009, 215,188 Americans suffered pedestrian injuries requiring hospital treatment. An additional 4109 were killed. Among the injured, young adults of college age had the highest incidence of any age group (NCIPC, 2011). Young adults may have elevated pedestrian injury risk for a few reasons. First, they are frequent pedestrians (Sisson et al., 2008), and therefore have greater exposure to risk. Second, they may walk more frequently at night and while intoxicated, both risk factors (Atkins et al., 1988; Zegeer and Bushell, 2012). Third, and the focus of the current study, they may walk while distracted by mobile devices.

The risk of distraction from mobile devices has grown dramatically over recent years. According to data from Pearson Education (http://www.infoplease.com/ipa/A0933563.html), mobile phone use in the United States has increased steadily over the past decade. Making causal assumptions based on annual data trends must be conducted cautiously, but it is curious that nonfatal pedestrian injury rates also show a trend of increasing over the past decade. The average crude rate of medically-attended pedestrian injuries from 2001 to 2005, for example, was 60.2; the comparable rate from 2006 to 2010 was 62.1. Among young adults ages 17–24, the average crude rate from 2001 to 2005 was 95.2; it increased to 104.3, on average, from 2006 to 2010 (NCIPC, 2011). Fatal pedestrian injuries do not show the same trend, nor do most other types of unintentional injury rates.

One reason distracted pedestrian activity is particularly dangerous is because multitasking-attempting to complete two cognitively complex tasks simultaneously – causes attention to and performance on one or both tasks to decrease (Kahneman, 1973). The human brain suffers when tasked with multiple

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complex activities simultaneously. Given the consequence of error while crossing streets and the need for safe pedestrians to simultaneously attend to multiple complex stimuli (Schwebel et al., 2009; Thompson, 2007; Whitebread and Neilson, 1999), one might presume that distraction by using mobile devices while crossing streets is dangerous.

In fact, empirical research suggests pedestrians distracted by a range of factors – ranging from eating to text messaging – may take greater risks than undistracted pedestrians (Bungum et al., 2005; Hatfield and Murphy, 2007; Nasar et al., 2008; Neider et al., 2010; Schwebel et al., 2012; Stavrinos et al., 2009, 2011). Poorly understood, however, is the influence of mobile Internet, a technologically-based distraction that is being used with increasing frequency, especially among younger pedestrians and that uniquely involves two aspects of distraction.

Recent data from the Pew Research Center suggest that about half of Americans ages 18–29 (49%) own a smartphone that can access the Internet (Smith, 2011). Of Americans who own a smartphone, 87% use their phone to access the Internet regularly, and 68% of them on a daily basis (Smith, 2011). Further, 60% of cellphone owners ages 18–29 have downloaded Internet-based applications to their phones, and 90% of those individuals use the apps at least weekly (Purcell, 2011). Using mobile Internet while crossing a street creates a unique and particularly distracting situation because pedestrians using the mobile Internet are distracted in two ways, both cognitively and visually. Those distracted by a telephone conversation – perhaps the best-understood cognitive distraction for pedestrians – are distracted cognitively but not visually. With both visual and cognitive attention compromised, both the cognitive processes in the brain and the perceptual processes of the visual system are impacted. Pedestrians might be at even greater risk for error when engaged in a task like browsing the Internet than when distracted cognitively but not visually, for example, by a phone conversation.

Given the rapidly increasing use of mobile Internet by young adults, and the potential distraction it creates in pedestrian environments, the present study tested whether pedestrian safety is compromised while using the Internet on a smartphone. A within-subjects experimental design was implemented whereby college-aged participants crossed a virtual pedestrian street both while distracted by mobile Internet and while undistracted. Pedestrian behavior was assessed through six outcome measures. We hypothesized that participants would take greater risks and be less attentive to traffic while distracted by mobile Internet in the virtual pedestrian environment. We also hypothesized these effects would remain after covarying demographic factors, frequency of crossing streets, and experience using mobile Internet.

2. Methods

2.1. Participants

Ninety-two participants (mean age = 19.05 years, SD = 1.18; 74% female; 41% Caucasian, 46% African-American) were recruited from Introductory Psychology classes at the University of Alabama at Birmingham. Inclusion criteria were age (17–25 years), owning a cell phone with 3G or faster Internet connection, and use of a cell phone to access mobile Internet applications at least 5 times per week on average. Participating students received credit as one way to fulfill a course requirement.

2.2. Procedure

Students participated in a single lab session comprised of several components. First, participants completed self-report questionnaires on various topics (detailed in Section 2.3) while the experimenter sent ten separate emails to participants' primary for use during the upcoming virtual environment (VE) trials (details below). Participants' cell phones were removed to a different room so the emails were left unread.

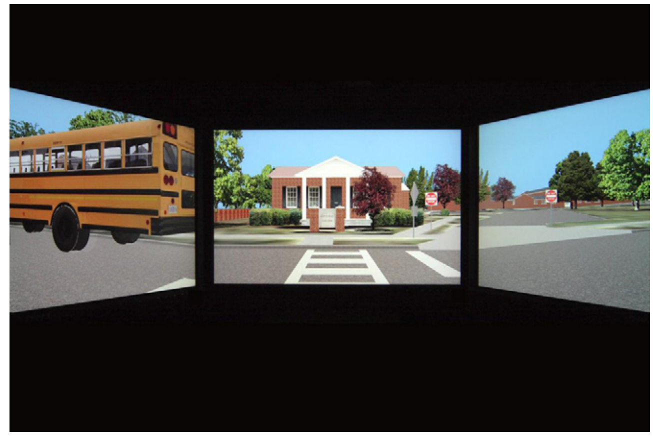

Fig. 1. Screen shot of the virtual pedestrian environment.

Second, participants' walking speed was assessed by having them walk a distance of 25 feet 4 times "at the speed [they] would use to cross the street." The four walking times were averaged to compute individualized pedestrian walking speeds. Third, participants were introduced to the VE. The immersive and interactive VE validly represents real-world behavior while offering the advantage of a safe research environment that simulates real pedestrian risks. Previous work established pedestrian behavior in this VE to possess construct, convergent, and face validity, plus internal reliability, based on correlations with behavior in the real-road environment, self-report of perceived realism, and other metrics (Schwebel et al., 2008). The environment consists of three large computer monitors, arranged in a semi-circle, which display bi-directional traffic in a 180° field-of-view on a two-lane virtual suburban road. For this study, traffic moved at a constant speed of 30 miles per hour with an average density of 525 feet between vehicles. Environmental sounds (e.g., bird chirping) and the sounds of cars approaching and passing are delivered through speakers. Fig. 1 displays a screenshot of the virtual environment.

During the study, participants stood in front of the VE monitors on a raised platform that replicates a street-side curb. They were asked to step down off the curb when they felt it was safe to cross the street. Stepping down activated a pressure plate which caused a race- and gender-matched avatar to begin crossing the virtual street using the previously-assessed walking speed. If the avatar safely reached the other side of the street, it stopped walking and an animated character appeared on the screen to provide one of two brief positive responses. If the avatar safely reached the other side, but was almost hit (i.e., there was less than 1 s between the participant and a vehicle), a cautionary response was offered. When the avatar was "hit" by a car, the screen froze briefly before the animated character appeared and offered a different cautionary response.

Prior to engaging participants in the VE, the experimenter demonstrated two crossing trials – one successful crossing and one purposely demonstrating a pedestrian being "hit" to avoid intentional unsafe crossings due to participant curiosity. Participants then stepped onto the wooden curb and completed a set of ten virtual reality trials to allow for familiarization with the VE.

Next, in order to provide a break between familiarization trials and experimental trials, participants completed further self-report measures (detailed below). They then engaged in a series of 20